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Photogravure
and
Rotary Photogravure

I. P. E. U.

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DEPARTMENT OF TECHNICAL AND CHEMICAL RESEARCH

CONDUCTED BY

NEW YORK PHOTO ENGRAVERS UNION No. 1

I. P. E. U. of N. A.

UNDER THE DIRECTION OF

EDWARD J. VOLZ AND AMOS H. SPALDING

RECOGNIZING the need for authoritative information upon the various branches of photo-mechanical processes of reproduction and the kindred lines of work, the New York Photo Engravers' Union decided to meet the issue, and to that end have established a Technical and Chemical Research Department which is to be supplemented with an Experimental Plant for the use of its members.

It is hoped through this department to further encourage the membership to become familiar with all methods of plate-making for printing purposes and not to confine their knowledge to any specific branch; to welcome and adapt themselves to any new process for the making of printing plates of any nature which may from time to time be required.

The many years of practical experience and the technical knowledge possessed by our members should aid them materially in developing as near perfection as possible all present known methods of engraving and plate-making, and should be the means of them introducing from time to time new and practical methods for illustrative purposes.

In order that every possible good may be derived from these papers, they should be read and studied carefully and put to practical use wherever possible. These papers can only be obtained through the committee in charge of this work, and are only intended for circulation among the members of the I. P. E. U.

This department is under the supervision of the Executive Board of the New York Union.

PHOTOGRAVURE

By M. RAOUL PELLISSIER

(Reprint from American Annual of Photography, 1916.)

PHOTOGRAVURE is undoubtedly the finest of all the mechanical or semi-mechanical processes and is becoming so well known and sought after that perhaps a few remarks on the process will be welcomed. It is unsurpassed for richness and depth, and yet the softest and most delicate details can be brought out, the whole unbroken by the use of any screen.

The first essential is a good negative from which all spots should be carefully eliminated by retouching. As photogravures are made from a positive or transparency this is of more importance than some would think. A print from a negative necessarily must lose something in the printing, and as the print has to be photographed to obtain a negative, still more final detail is lost.

Now, in a double camera, that is a camera with the lens in the middle and the bellows (square) continued ahead with adaptable carriers in front, we place the negative to be photographed to obtain our reversed positive. The simplest way to assure its being reversed is to always make sure that the negative is placed in the front carrier, film side out, or glass side towards the lens.

This reverse positive, when dry, should be carefully retouched, all white spots touched out but never so that they appear heavier than their immediate surroundings, as they will in that case be accentuated in the etching, and be difficult to get rid of. Above all put in with a soft pencil a few crisp snappy blacks where possible and the resulting plate will more than pay for the trouble and time. No mechanical retouching after the plate is etched can equal the effect and wearing qualities of the etching itself.

Now paste thin orange or red paper all around the edge of the positive, the inner edge of the paper being about one-eighth of an inch beyond the edge of the work or picture, itself and lay aside for the present.

We must first obtain a roll or pieces of Autogravure Carbon tissue, which comes from the Autotype Co. of London and

can be obtained from the American agents, George Murphy, Inc., of New York. This is made expressly for this purpose and can be had in various colors. Personally I prefer the No. 3 Burnt Sienna. The object of the colored pigment is simply to enable one to see one's work as it progresses. This tissue is now to be sensitized and for this purpose a solution of bichromate of potassium in water must be made according to the directions. This solution should be placed in a deep dish somewhat larger than the piece of tissue to be sensitized and the latter placed therein. It will almost immediately curl up and should be uncurled with the fingers and all bubbles or foreign matter gently brushed off with a flat camel's hair brush. Keep unrolling it from side to side until it lies flat in the solution, but care must be taken never to allow the fingers to touch the surface, or the greasy marks so obtained will repel the acid in etching and cause blemishes and much hard work to remove.

This operation of sensitizing must be performed in a dim yellow or orange light, preferably in the late afternoon and the sensitized tissue hung up by pins or otherwise in the dark, being dry and ready for use in the morning.

Next, obtain from some reputable concern — I might mention the New York Copper Co.—some special copper made for photogravure. It is especially polished with a very high finish and should be almost as good in reflection as a mirror. This should be of a size rather larger than the paper on which the finished plate is to be printed and must be absolutely chemically clean and free from grease. To prevent tearing the fingers in handling and catching in the towels in drying, round off the edges and corners of the copper both back and front with a medium file first, finishing with a finer one.

Boil up in a kettle a strong solution of potash and water and with the help of a stiff brush and a box of whiting in which the wet brush is rubbed, clean the copper thoroughly, washing under running water and removing the tarnish with a weak solution of nitric acid in water. Have several towels (the common dish towel is best) ready and dry thoroughly and rapidly, breathing on the copper at the last and again rubbing with the driest towel.

A graining box must now be made. This is a square box, the size depending on the size of plates to be produced, made

so that it revolves. Any attachments, however, must be on the outside and no rod can be run *through* the box at the center. A door about five inches wide, hinged at the bottom, should be placed about one-fifth of the way from the bottom of the box and level with it four or five rods run across from front to back inside to support a board on which the copper plates are later to be placed. A great improvement for more serious work is a high stationary box with a circular bottom, operated with a fan attachment which revolves and very much lessens the time of the operation.

Now, place in the graining box several pounds of the *finest* ground bitumen or asphaltum and revolve rapidly. Let stand for a minute or two to get rid of the coarser particles and then place the cleaned copper plates on a board and gently insert in the box. Care must be taken to eliminate all draughts and any cracks in the box should have slips of heavy paper pasted over them. The fine particles of bitumen in suspension in the box will settle in about half an hour, when the plates can be carefully removed and "cooked" or "burnt in" over a gas stove. This is best accomplished by holding the plate at the corners with pliers or nippers having a flat holding surface. Start by heating from the corners inwards, moving the plate continuously and evenly. It will gradually turn blue, but the heating must be continued until in holding the plate down against the light it appears to be of a dull red brown color, uniform all over. The grain may be examined with a strong magnifying glass and each individual speck should be of about the size of the space between the specks.

We now take our sensitized tissue in a dark-room or room with ruby or yellow light and cut it to size, allowing for at least one-quarter inch more on each side than the size of the space within the paper border on the positive. Care should be taken to cut square with a sharp knife and steel rule, preferably on a zinc covered board. Rough edges cause trouble and cutting square is a great help in getting correct position on the copper.

Purchase a Wynne Actimometer, or printing gauge, and a little experience in comparing the tints with the density of the positive to be printed from will soon enable us to tell how far or to what tint the printing must proceed. It is impossible to tell when the sensitized tissue is correctly printed

by merely looking at it, hence the use of the actimometer. Place in the latter a piece of P. O. P. and superimpose the cut tissue on the film side of the positive, taking care to allow it to project evenly on all sides over the edge of the picture itself. This is readily ascertained by adjusting while holding up to a lighted gas jet.

Now, place in the printing frame, using backing of several sheets of white blotting paper and a piece of felt and expose with the actimometer, side by side, but not in sunlight, as it tends to flatten the final results. Examine the actimometer from time to time till printing is complete.

While printing is going on fill a deep porcelain dish with pure cold water and brush off any foreign matter on the grained plate with the hand under running water, pour a very weak solution of sulphuric acid and water over the plate to remove tarnish. Wash again under running water and place in the disk. Take the printed tissue out of the frame and with the shades down in daylight, or with the use of a gas jet at night, place it in water, gently brushing off any fluff or other foreign matter with a flat camel's hair brush. When the tissue begins to uncurl, rapidly place it in position over the copper and remove from the water, removing all superfluous moisture by using a flat rubber squeegee from side to side in all directions. This must be carefully and thoroughly accomplished to make the tissue adhere and to remove any air bubbles. Stand in a rack for ten minutes or a quarter of an hour to set.

Take the same deep porcelain dish and after thoroughly cleaning fill with warm water of a temperature of about 110 Fahrenheit and immerse the plate in this. After a few minutes press the edges of the tissue with the fingers and as soon as the color runs out the paper backing is ready to be removed by inserting the finger nail under a corner and gently pulling it off the plate. Wash away all soluble gelatine by splashing the warm water over the plate till no more can be romoved. It is here that the color pigment begins to demonstrate its uses. Then swill under cold water faucet and place in a rack to dry, or if in a hurry place in a dish or pure wood alcohol for a few minutes.

Meantime some powdered bitumen should have been thoroughly dissolved in benzole and diluted if necessary with

more benzole or a little turpentine until of a consistency to run smoothly and easily from a ruling pen. Make it just thin enough to run, as if it is any thinner it will spread and do more harm than good. This is commonly known as Brunswick black.

With the assistance of set squares the plate must now be squared and a mark made in pencil outside the picture beyond the ends of imaginary lines at each side of the picture. These lines must be within the edge of the image, as any blank copper beyond that edge will etch black. The lines must only be marked outside the work, as if the pencil is allowed to mark the tissue itself, unless very carefully done, abrasions will follow. Now, fill the ruling pen and with a steel rule as guide rule around, using the above pencil marks. It is advisable to do opposite sides alternately, so that when a ruled line is crossed by another ruled line the first has had a chance to set and no blur occurs at the corners. With a brush paint all the exposed copper with the Brunswick black, care being taken not to allow it to flow over the lines and also to remove all bubbles. Put aside to thoroughly set, which should not take more than half an hour. The more the Brunswick black is diluted with turpentine the longer it takes to dry.

Obtain some pure perchloride or iron (lump) and place in a non-metal jar of any kind within a saucepan of water (water kettle) over a gas heater until melted. When sufficiently cool measure this and add to it half the amount of pure water.

Bordering wax can be obtained from any process supply house, or it can readily be made at home. Soften in warm water, roll on a bench or table till rolled out round and about three-quarter inch in diameter, then press firmly down all around the plate. (Adhering to the bench when rolling out may be stopped by sprinkling thereon common talcum powder.) The height may be increased by thinning out at the top by pressure and at the corners the wax must at least be straight and perfectly sloping inwards to prevent the etching solution from flowing over. At the lower right hand corner thin out and form into a lip by which to pour off the acid.

For etching we have our perchloride solution in a measure, an empty cup, a teaspoon and a small vessel containing boiling water. Take the mould as the prepared plate is now called

and pour over it some of the perchloride, care being taken to cover it all over AT ONCE. Flood it and then remove all but enough iron to well cover the surface. Rock or move the plate so as to keep the liquid in continuous motion, as where the acid is at work, if stationary it will deteriorate before the etching is complete. Etching will be plainly seen as soon as it commences, as it shows black. An average time that this should be complete in is about eight or ten minutes. It depends very much on the grain — the finer the grain the shorter the etching or the grain will crumble and vice versa. As the etching progresses add a half teaspoonful of hot water from time to time. Place it in the cup and pour off the perchloride into it so that it mixes thoroughly. Experience alone will tell you how much water to add. The etching must be gradual from start to finish so that all tones are relatively correct, and it is well to pay particular attention to the final tones to insure getting all the delicate detail. It is better to over-etch than otherwise, as retouching for high lights on the plate is a simple matter.

Now pour off the perchloride and allow cold water to run on the plate to remove all vestiges of acid. Add warm water and allow to stand a few moments, when the wax will soften and can be removed. Place the plate on a sloping board in the sink and pour on it hot water and a strong solution of potash and scrub with a brush and whiting, care being taken to obtain brushes that are made for the purpose, or scratches may be caused. Wash off under the faucet and flood the plate with a weak solution of nitric acid to remove all tarnish. Repeat these operations until the etching residue and the gelatine are all removed, and then dry. Place on a flat surface and with oil and Putz pomade, or any first class non-scratching metal polish, rub until the surplus grain is all removed and the plate is now ready for a rough proof.

Space will not permit me to go into details of printing, retouching and steel facing beyond one or two remarks.

For the printing of photogravures a plate printing press is necessary on which the plates are printed by hand, the paper being damp and afterwards dried and pressed.

For retouching a diffused light is necessary — a paper screen will do—and such tools as scrapers, burnishers, roulettes and dry points. Blacks and high lights can both be added with

ease after a little practice, spots and blemishes removed and the plate greatly improved.

When the proof is finally O. K.'d the finished plate should be thoroughly burnished on the margins outside the picture proper and quite free from scratches, or these will show in the prints and give the printer endless trouble. The copper is soft and will soon wear out, but a thin infinitesimal coat of iron protects this and must always be removed as soon as it shows signs of wear.

This steel facing is accomplished by immersing the chemically clean plate in a bath consisting of a solution of sal ammoniac and water to which has been added sulphate of iron, and in which hangs a sheet of iron as an anode. The current being turned on, the plate is allowed to hang in the bath for five minutes, then removed and scrubbed with water and whiting, washed and replaced in the bath. This operation must be repeated three or four times until a sufficient thickness of iron has been deposited, when the plate is removed and dried very rapidly to prevent rusting and immediately oiled, when it is ready for the printer.

It is a good plan to stamp a number on the back of each plate, keeping an album in which an impression from each is kept for reference with its corresponding number. This should be done just before steel facing.

In the whole process it is necessary to constantly remember three things: care as to absolute cleanliness, care as to minute details and the use of pure chemicals and water.

I feel that many important details are herein lacking, but space will permit of no more. I shall be glad at any time to advise or help anyone desiring any further complete information.

COMMITTEE NOTE—Experimenting on photogravure plates should prove both interesting and instructive to our members, the experience and information gained will prove very beneficial if contemplating rotogravure work. If inconvenient to erect a graining box, the same procedure can be followed of using a positive screen when making carbon prints as explained in the rotogravure process. The Metzograph screens numbers 5 to 8 being especially adaptable.

INTAGLIO PROCESS MARVEL OF PRINTING

(From the American Photo-Engraver, March-April, 1914.)

AS part of the issue of the Public Ledger of January 25, 1914, was a twelve-page supplement filled with intaglio process engravings, the result of considerable experimenting and earnest effort on the part of the engravers and printers engaged upon. As it stands, this supplement is one of the most remarkable achievements in art printing ever due to newspaper enterprise.

The large edition of these supplements was printed on the Public Ledger's two rotogravure presses, which were built in Germany and represent the latest improvements introduced into this remarkable machine. While the intaglio supplement was not the first attempt at intaglio printing by an American newspaper, it is the first time the process has been used so extensively in a single issue, and for the first time what had been regarded as a refractory method of printing has been tamed by the skill and patience of expert workmen.

But the most remarkable phase of the intaglio supplement is the fact that it is only the forerunner of a regular Sunday feature of the newspaper.

No more beautiful method of reproducing works of art has ever been devised, and while the basic principles of the intaglio method have been utilized for half a century, it was only within recent years that the process received that rapid advancement and improvement that made it a commercial success.

Thirty years ago such a supplement as the Public Ledger's would have been impossible for two reasons. In the first place it would have required probably a year's time to prepare and print, and then the cost would have been prohibitive for such a large edition. Indeed, a writer on reproductive processes in 1877, referred to the intaglio process then in use as being entirely unable to compete with photolithography for cheapness or with surface printing—such as the half-tone block, for rapidity and cheapness. But, in the meantime, the intaglio process has been revolutionized, and the result is that it is now possible to obtain with a newspaper works of art as beautifully repro-

duced and as effective as the finest and most expensive productions of a quarter century back.

For a few years some of the expensive European illustrated weeklies and monthly magazines have, from time to time, issued a few pages of pictures printed by the intaglio method, but the uncertainty that heretofore has attended all efforts to make the process a regular feature has prevented the process from being generally used.

While the beauty of the velvety shadows that are found in reproductions by the intaglio process delights the eye of all who enjoy artistic printing, and even attracts the attention of all who even see them, there are other advantages in the use of this wonderful process. While intaglio etching is as old as etching itself, and the photogravure methods upon which the present examples of intaglio are based have been known and used to a limited extent for the last forty years, the genius who harnessed the method to the rotary press revolutionized the whole art, and has made it accessible to commercial and newspaper purposes which previously had not been dreamed possible.

It is a strange but true assertion that the intaglio, the best reproductive process known, after its plates are made, gives no further trouble to the printer. That does not infer that there is no difficulty to be encountered in printing, for there is considerable, but this trouble does not lie with the plate, but is to be attributed to other parts of the printing process. In other words, the plate when it has been affixed to its position on the press, is a perfect piece and does not require what is technically known to printing as "make ready."

This is best illustrated by the statement that the use of fine half-tones require frequently many hours, or even a few days, where there are large surfaces to be overlaid, to get the best impressions from the half-tone block. With the intaglio process, when used on the modern rotary press adapted to the work, no make-ready is necessary.

A great saving of valuable time results from this fact, and it is due to this, in addition to the beauty of the result, that the intaglio process is destined to become more and more popular.

About two years before Guttenberg invented the movable types and caused a revolution in the dissemination of knowl-

edge that has in turn changed the train of events in the whole civilized world, a Florentine goldsmith, Maso Finiguerra, discovered intaglio printing. He succeeded in fixing on a piece of paper some black pigment that he had rubbed into a silver plate which he had engraved in intaglio. The impression which he obtained was the first step toward all etching processes that have followed. What are called painter etchings, or designs etched or scratched on a metal surface by an artist, and subsequently printed on a plate press, are intaglio engravings; thus the name card which nearly every person carries is an impression from an intaglio engraving.

But what we have come to recognize as the intaglio process is quite another matter. This depends upon a still later discovery—that of the sensitive salts of silver, or in other words, photography. Claimants for the honor of the discovery of intaglio processes are so closely dependent upon one another that at this late day it would be hazardous to assert that it was Talbot, or Swan, or Klic, or Merten, or Woodbury who is responsible for the modern intaglio process, for each of them—and there were others, too—has been instrumental in the perfection of the process and all have had a share in making it commercially possible. There are those who see in the younger Wedgwood's experiments with fugitive profiles by the agency of light, as he termed the images on sensitized paper which he used, had something to do with pointing the way, and Wedgwood conducted these experiments as far back as 1802.

Yet Wedgwood, by using paper, did influence Talbot, who was the first to make paper photographs, and in experimenting along these lines made use of the carbon gelatin process, which, as will be later noted, is the base of the present intaglio process, when applied to work done on a rotary press.

Talbot also obtained patents for photo engraving on steel in 1852, and for photo engraving on copper in 1858, which dates were long before any photo engraving was regularly in commercial use anywhere. The process of Talbot contained all the essentials of successful photogravure, or intaglio engraving, but of course was lacking in those characteristics that are required by a commercially possible process. Yet to William Henry Fox Talbot is due the attention that since his time has been paid to perfecting the intaglio process.

Sir Joseph Wilson Swan, another British experimenter

in photo engraving, carried to still further advance the Talbot process. In 1864 Swan patented his carbon process, which was an improvement on Talbot's inasmuch as this made use of a carbon tissue. The rest of the process was rather complicated and too much so for consideration here.

This carbon tissue briefly may be described as gelatine to which has been added a salt that is sensitive to the action of light, and, when the carbon tissue is only used for making rich, permanent prints on paper, such as may be seen at fashionable photographers, there has been added a pigment, which gives the needed color to the tissue. The tissue is exposed to the action of light through a photographic negative, and then developed in water. Where the tissue has been exposed to the light it has hardened the gelatine, and where the latter has been protected by the opaque parts of the negative, it is soluble, and washes away. The result is a beautiful permanent image which may be while wet affixed to any flat surface. In fine photographs this surface is cardboard, and in intaglio processes, it is affixed to metal, where it awaits another step in the engraving process.

Finally came Karl Klic of Vienna, who made a happy combination of both Talbot's and Swan's methods, about 1898, but, what was equally important, he devised a press and adapted the intaglio process to it for printing intaglio reproductions rapidly, from a web of paper fed through the machine just as the modern newspaper press is fed. The adaptation of the intaglio process to the rotary press was not quite so simple a matter as it appears to have been in relating the fact.

Karl Klic (whose name is pronounced as if written Klisch) is a Bohemian by birth, but for the last dozen or more years he has been a resident of London, where he is connected with the Rembrandt Company, which concern admittedly executes the finest intaglio work in the world. It is said that the Bohemian was inspired to adapt the process to a rotary press by observing that the presses that print wall paper and calico, and those that print on silk and other fabrics were virtually intaglio presses. Consequently the machine was adapted to print from intaglio engravings on paper, and for years the method was kept a secret, for it is said no patent was obtained for it.

Secrets of that kind are difficult to protect where there are

enterprising experimenters, as there have been for years in the realms of photo-engraving processes in various parts of Europe. By degrees the work was being done in various European countries, but all the independent workers met with difficulties that seemed to be insurmountable, and finally Herr Klic went to London, where he became connected with the Rembrandt Company and gave to it his best advice and skill.

Within the last year efforts have been made in this country to get a hold for commercial intaglio prints, and now there are numerous concerns that are executing excellent photogravure that surpasses anything done a quarter of a century back, when photogravure was the most expensive and the slowest photo-engraving process, and limited to small editions. The Public Ledger was the first American newspaper to begin the regular use of the intaglio process, and naturally a description of just what is meant by this intaglio process, and just how it is accomplished, will be of interest.

In the intaglio supplement of the Public Ledger both pictures and text are printed at the same time, and both are intaglio. As difficulty is encountered in printing much type engraved in this manner, it is necessary to make the textual reference to the pictures as brief as is consistent with adequate description. Therefore, the procedure is something like this: The pictures are selected by the editor and sent to the engravers, the shape and number to a page and the place of each on the page, being indicated to the engraver. At the same time the titles and descriptions to each picture are set up in type in the usual manner, and proofs of these lines taken. These are then sent to the engraver, who now has both text and pictures. He also knows where each picture should go, and the arrangement of the pages.

The pictures must first be, if necessary, either enlarged or reduced to the size they are to have in the printed page. When this is done the page is arranged, and the whole photographed on a dry plate. This negative is exactly what every amateur photographer is acquainted with, excepting that the photo-engravers must be correct in its time and in its development, for the result must be perfect; otherwise, the result will be worse than a badly printed half-tone.

From this negative a positive, or transparency, is made.

Thus far the process is pure photography, but here the turn is made where the process enters into the operation.

In order to understand why the operations that follow are performed it becomes necessary to inquire what result is required. The half-tone block, which is now familiar to almost everybody, is a block that receives ink upon its surface and releases it, upon pressure, to some other material — usually paper. The intaglio process at the time the engraved plate is impressed by the paper has a perfectly clean surface, and all the ink it has received is held in its thousands of tiny cavities, known technically as screen, and not altogether unlike a reversed half-tone.

And yet the intaglio plate is unlike an inverted half-tone to the extent that, like the painter-etching, its shadows are deeper than its middle tones, while its high lights are almost without depth, and theoretically they are entirely smooth surface.

The rotary press requires a curved printing surface just as the newspaper press does. Consequently the plan of the wall paper and the calico printing machines suggested that the engravings be made on a metal cylinder. To do this, obviously it would be impossible to make the "print" for the etching upon it from a glass negative or positive, and the carbon tissue, already described, is here the obvious solution, hence its use at this stage of the process.

In order to obtain the "grain" or "tooth" to the printing plate, which is essential in an intaglio plate, in order to hold the ink or color, until released upon the paper by pressure as the paper passes through the press, the use of a screen, the opposite of a half-tone screen, for this must be a positive rather than a negative screen, usually referred to as a "cross-line" screen, is used. This screen in the work in the intaglio supplement has 175 lines to the inch. This means that these lines are so close together that the unaided eye cannot detect the screen effect, and thus the tantilizing and obvious screen pattern of the commercial half-tone is obviated, and the effect is a beautiful velvety impression.

Before the transparency or positive is used to translate the image to the carbon tissue it is placed in the hands of artists who use this opportunity to retouch the places that would be benefited by such treatment. At this time also slight corrections

may be made by the artist. The retouching having been completed satisfactorily, the transparency is placed in contact with the carbon tissue, and a "print" made in the usual photographic manner, by exposing to actinic light, usually to the light from a powerful arc lamp. When this has been done the carbon tissues are made for the other pages that are destined for the same printing cylinder, and all of them are arranged in an immense printing frame, familiar in smaller sizes to amateur photographers. In this frame is already a large cross-line screen, already alluded to, and the carbon tissues placed behind it, are kept in contact by pneumatic pressure, while the frame and its contents are exposed for a few seconds to the electric lights.

The tissues are now placed in their order upon the copper cylinder and squeezed upon the metal, which has been rubbed with charcoal to remove grease and surface scratches. The carbon tissues are all handled upon paper and the development that follows is carried on from behind the tissue; that is, on the side toward the operator, and through the paper.

The paper is thoroughly saturated with water. As the paper is coated with a skin of gelatine, which has been sensitized where the light has not penetrated the tissue, it leaves that part of the gelatine soluble which the water readily dissolves and permits the paper to be peeled off the cylinder, leaving a photographic resist upon it.

The cylinder is now "varnished" on its exposed parts, and the work of etching begins. To accomplish this the cylinder is laid in a large trough where there are supports to hold the cylinder, but give it all the movement the operator requires. When the etching is carried as far as is believed necessary, and for such editions as are required for the Public Ledger, it is necessary to etch in the solids, or shadows down to quite 9-1000 of an inch, the cylinder is cleaned off and set on the press. As each cylinder prints but a single side of a paper, it is necessary to have two, and this results in virtually combining two rotary intaglio presses.

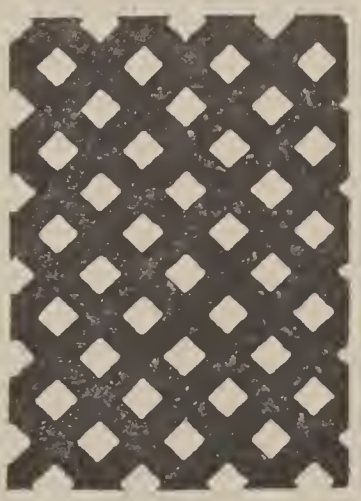
As has been related, the paper is fed to the press from a web or roll, just as is used on newspaper presses, excepting that a different kind of paper is advisable. For the intaglio process soft, absorbent paper is best, for it absorbs the ink quickly, and at the same time gives least wear to the engraved

cylinder. The paper runs from the web to the printing cylinder, where it receives the impression, and is then carried up and over a large drum which is heated sufficiently to dry the ink before it is passed to the next part of the press and receives impressions on the other side of the paper. Subsequently it is cut into sheets automatically, and by the same means piled up sheet by sheet on a table placed to receive them at the foot of the press.

Those who work the process will tell you one part or another part is the crux of the whole operation. Some contend that the secret of success lies in ink or paper, and it is admitted that the process demands the greatest care in each stage and also in the selection of both paper and ink.

To the untechnical observer the most interesting part of the press work is the manner in which the plate or cylinder receives its ink and the ingenious attachment which relieves it of all surplus color. The engraved plate or cylinder receives its ink from a wooden roller which is partly immersed in a trough of rather liquid ink. The ink is of volatile character containing benzine and turpentine as diluting agents. The surplus ink is scraped off by a long knife, which scrapes the cylinder lightly, and the pressure by which the ink is impressed upon the paper is obtained by means of a rubber roller acting between the paper and the engraved cylinder.

The copper cylinders used in the process are orginally about three-quarters of an inch in thickness, but after being used are placed upon a lathe and the engravings removed by means of a revolving stone. Before they are fit to be again used they are placed upon a burnisher and receive a high polish, and then are ready to be engraved again.



The half-tone, negative screen.

The gravure positive screen.

THE ROTARY PHOTOGRAVURE PROCESS

By COMMITTEE, PHOTO ENGRAVERS UNION No. 1

THE keen observer of progress and events, in the Graphic Arts, has heard and read much for years of photogravure; in fact, the process was always interesting and good results were obtained long before the half-tone process was perfected. It was, however, slow of development and never until recently made commercially possible, the operation being slow and tedious, which naturally made it expensive.

The introduction of the cylinder gravure for the rotary press has, however, revolutionized the process to such an extent as to make it a keen competitor, and a factor to be considered in the plate making industry, and has aroused renewed interest in its results and in the methods of its operation.

That good results have been obtained cannot be denied. That the work is appreciated is best demonstrated by the ever increasing demand to the publisher, for more and larger gravure supplements. As in all intaglio processes, the shadows are deeper and richer than in surface printing; the middle tones having a delicate and soft appearance, while the general gradation of color is far greater in range than can be had by any other method of printing. This is perhaps best explained by the fact that in all surface printing, the ink is delivered to the paper in one thin layer, it being as thick on the lightest dot as on the deepest shadow, while the important thing in intaglio printing is the fact that where it is the darkest the ink is actually thicker and grades down in amount, through all shades to the extreme high lights, which are cleaned off to pure white. This actual standing of the ink in relief on the paper in the deeper tones gives a velvety appearance, which cannot fail but appeal to the eye.

Half-tone, or any other surface printing with a fine mesh, depends almost entirely for its best effect on a clear crisp impression and a uniform gradation of the size of the printing dot. If the dots are ragged at the edges and the white spaces blurred with ink the impression immediately appears muddy and slurred. By pressing a half-tone plate against a rough

paper or even a paper with a texture to its surface, the result is always a broken tint, as the ink only touches the highest points of the paper, in an attempt to force the paper and ink into even contact by overlaying the effect will invariably be squashed and muddy. Half-tone, therefore, is only at its best when using paper with a smooth or finished surface. On the other hand, these difficulties are not in evidence with intaglio printing; here the screen image is engraved into the copper surface and by the medium of the rubber impression cylinder the printing dot and paper are always in perfect contact. The dots cannot spread, they do not appreciably wear, and carry a uniform amount of ink for each impression, making it adaptable to either the smoothest finished or roughest and softest stock alike.

In color printing the rotary-gravure will also be a factor in the future; already two New York concerns are turning out work in color which is very satisfactory and pleasing, and while certain difficulties are still to be overcome in the matter of perfect register, the work produced shows that the possibilities exist for good results by this process.

Following is a simple description of the rotary photogravure process, as most generally used. First understand that there are several methods of producing this work, which, although being used extensively, is still in more or less of an experimental stage, each of the concerns, at present engaged in the business, using some slightly different method; the general workings, however, and the final results obtained being about the same.

Any copy with tone value will be suitable for gravure; in other words, any copy, that will allow of good half-tone reproduction will be equally well suited for gravure work, the best results naturally being obtained from the copy with strong contrasts and good color value.

A continuous negative is first made (that is, a negative without the screen as is used in half tone). In the past, dry plates were used almost exclusively; these are now being replaced to a great extent with wet plate negatives, both are equally practical, for while the dry plate allows of easier manipulation by the retoucher, the wet plate negatives are sharper and in many cases need little or no retouching whatever.

In case of a combination page, or pages, where various subjects with text are to be illustrated, as in newspaper work, magazines, etc., where the dry plate method is to be used, the layouts

or drawings are made for same size reproductions; a complete form being made up. (This form is used to hold the negatives in a layout for the making of the positives as will be explained later.) This form is made by laying a glass the size of the plate to be made over the drawing or photograph, then covering all the outlines and outsides with opaque, or black paper, simply leaving a space for the negatives, to set in their proper places. These negatives are then cut to fit their proper spaces, in the form in which they are placed, all transparency around being opaqued, so that when the dry plate positive, which is later made from this form, or layout of negatives, is complete it will show a clear film. (Wet plate positives have also been used with satisfaction.) All line work such as borders and type, where any are to appear, are made positive, by the wet plate process and stripped into place on the positive form, which is then complete and ready for retouching and printing.

In using negatives made by the wet plate process the continuous negative is made, which is later inserted into a layout, or form, the same as in the half-tone process, a dry or wet plate positive then being made from this negative.

In using either the wet or dry plate process it is essential that all negatives be of the same density, with covering (or veil) in the blacks and shadows, and of the same even strength in the high lights.

Most of the improvements which on half-tone work is done on the copper plate by re-etching and burnishing and the cutting of panels and white lines, is in gravure work, done on the negative or positive (generally on the latter) shades and detail being accentuated and touched in with an ordinary lead pencil; the middle tones being reduced with liquid retouching medium, and the pure whites being cut completely out of the positive film. On certain subjects an air brush is also used to good advantage.

The positive forms are next composed for the cylinder in their proper page relation if to print in book or newspaper form; in other words, the work which in a printing establishment is done on what is known as the "stone" or make-up table, is here done by assembling the positives.

When properly assembled these aggregate positives are printed on to sensitized carbon tissue in a vacuum printing frame; (This carbon tissue is a gelatine covered sheet of paper made

sensitive by immersing in a bichromatic solution.); it is here where much care must be taken to secure uniform even prints of proper tone value, as the color of the tissue hides the effect of light, the printing is done with the aid of an actinometer, after which this same tissue is put into another vacuum printing frame fitted with a screen, and printed on top of the print of the positive. (This method of printing the carbon tissue can be reversed by printing the screen first and the positive after.) (It must also be remembered that the negative or positive can be made through a screen; this, however, allows of little or no retouching on the positives and is not generally used.)

(It is also possible and in the early stages of experimenting was frequently practised to make separate carbon prints of the positive and the screen, then transferring the latter over the former onto the cylinder; this to prevent pin-holes or "devils," the one film covering the holes of the other. With careful operation, however, this practice is unnecessary.)

Just a word in reference to the screen: The carbon prints being made from positives, the screen used must also be a positive screen and not a negative screen, as used when making the half-tone plates. There is also this difference to note which is very essential, in a half-tone negative screen the width of the lines which cross each other are equal to the width between, in other words, the width of the opaque lines is equal to the white transparent openings. On the other hand, the gravure positive screen is different in that its transparent lines which cross each other are thinner, being usually about one-sixth the width of the opaque squares between.

The carbon tissue having been printed, both with the positive of the subject and the screen, it is floated in water and all loose pigments and foreign matter carefully removed by gently washing with a flat camel's hair brush, after which it is placed onto a seamless copper cylinder, film part down, and gently but firmly squeegeed into contact so as to remove all air bubbles and to make the film adhere firmly to the copper.

After having been allowed time to set and dry, the paper part of the carbon tissue, being on the outside is carefully removed from the gelatine portion, by immersing and washing in warm water of a temperature of from 100 to 120 degrees Fahrenheit, which leaves the gelatin portion only, adhering to the copper cylinder.

The cylinder in this condition, after being allowed time to dry, or, if in a hurry, dried with pure wood alcohol, is ready for etching, the film acting as resist to the etching solution. Margins and other parts not to be etched are protected with asphaltum, same as in any other etching, the cylinder revolving in an etching bath, the etching solution being iron perchloride fourteen pounds to one pound of ferric hydrate (ferric hydrate is the precipitate made by pouring ammonia into perchloride solution) just covered with water and stirred well, hot water being preferable. Test with Baumé hydrometer to 45 degrees. Dilute separate portions to 43, 40, 38, 36 and 33 degrees. The weaker solutions penetrate the gelatin more easily, and therefore should not be used until sufficient depth is obtained in the dark and middle tones with the stronger solutions. After the etching is complete (the etching in its deepest tones is not more than 5/1000 of an inch deep) the cylinder is thoroughly cleansed of the residue and the gelatin, when more or less improvements can be made by the careful manipulation of roulettes, dry points, scrapers, burnishers and charcoal, also by retopping different portions and re-etching. Blacks, shadows and high lights can be added with ease after a little practice, spots and blemishes removed and the general appearance of the work greatly improved. In the future much local improvement and finishing will undoubtedly be made on the etched cylinder, same as is at present done on the flat etched half-tone plate.

The etching and finishing being complete, the cylinder is now ready for the printing press, which in its operation is quite simple. The copper cylinders are hollow and generally from one-half to three-fourths of an inch in thickness, they are mounted on mandrels which are collapsible for their removal when not coupled to the press. When both sides of the paper are to be printed two cylinders are prepared, one for each side, both cylinders being adjusted on to one press, usually one at each end. For color work three cylinders have been placed on one press. As the printing cylinder revolves it passes through a fountain or trough of ink which covers the entire cylinder. (This ink is quite thin, being about as heavy as cream; it is made of an aniline dye dissolved in a solution consisting largely of xylol; it also contains benzole and turpentine and is, therefore, extremely evaporative. Almost immediately, however, it passes under and in contact

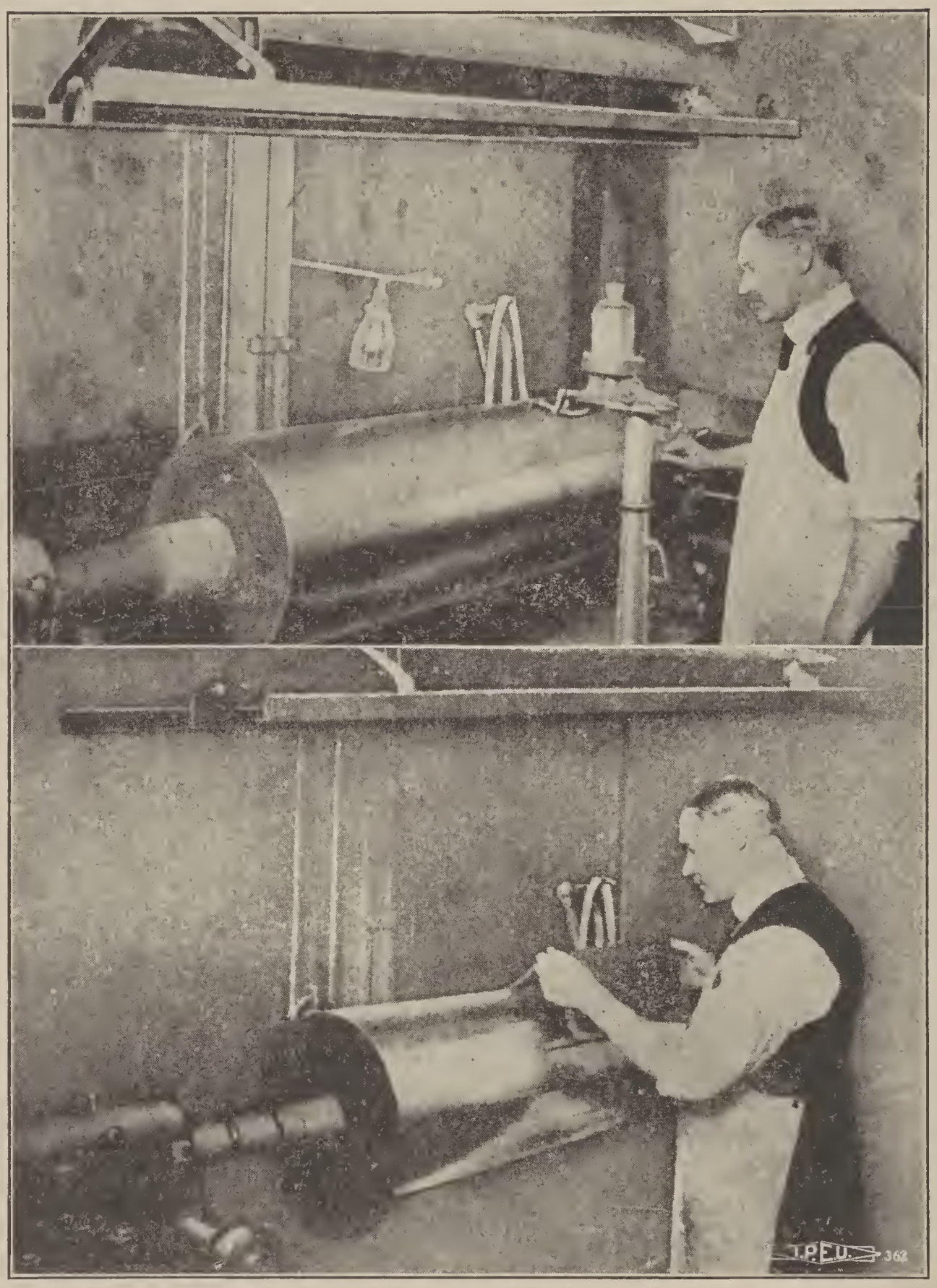
with a long steel blade or knife which is smoothly sharpened and known as the "doctor." This "doctor" moves slowly from left to right, and is so finely adjusted as to wipe perfectly clean the entire surface of the cylinder, leaving the ink only in the cavities or screen pockets of the etched image. The paper which is fed into the press from a spool or web passes between the inked cylinder and a rubber surfaced pressure cylinder and is forced into and picks the ink from the cavities of the etched cylinder. It next passes over a heating drum, lined with hot air, gas or steam pipes for drying, and then on to the other cylinder for printing on the reverse side, then back over the heating drum and on to the cutter and folder.

The ink at present used dries almost immediately; no doubt in the near future an ink will be manufactured which will make it possible to do away with the drying compartments. In fact, this has already been done with slow speed printing. This quick drying of the ink is important, as it not only prevents offsetting but make it possible for the web to continue rapidly from one cylinder to another.

The quick drying has also made possible the multi-colored rotogravure, the paper web running from one printing cylinder to others for as many colors as may be necessary. In smaller printing for color work it has also been found practical to print individual fed sheets, some very fine three and four color work having been produced.

After an etched cylinder has served its purpose it is placed on a lathe and ground down by means of a revolving stone, and polished with charcoal, until its surface is perfectly smoooth and all trace of the etching removed. In this manner cylinders can be used repeatedly. It is also possible to deposit a new shell of copper over the etched cylinders by electrolysis, when they can be turned true in a lathe and polished.

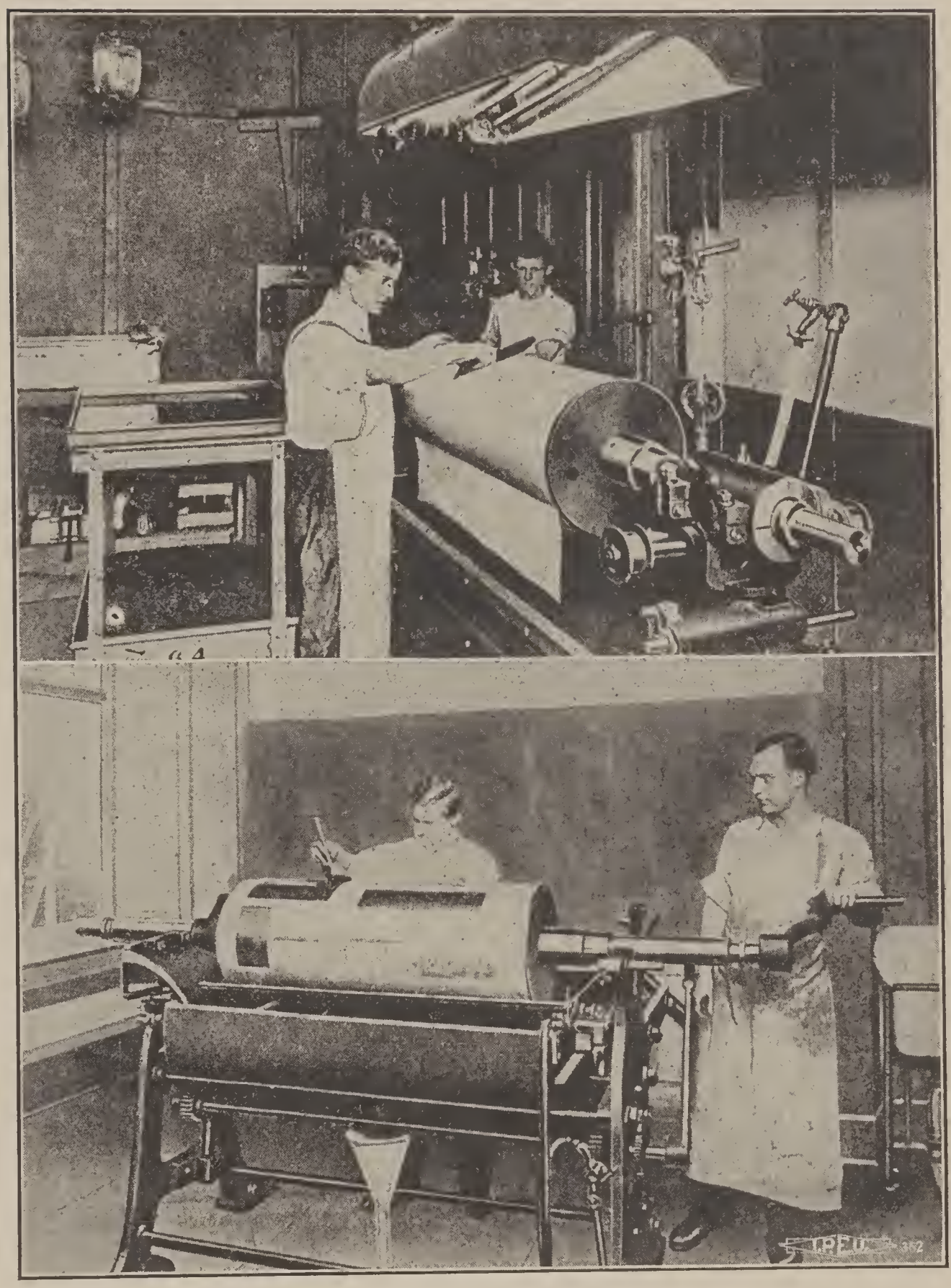
Rotogravure has undoubtedly come to stay. It must be remembered that the first rotogravure press in this country only started in operation a few years ago; already it has lured no small amount of work into this channel. That there is big room for improvement must also be admitted; the process is simple and as has been demonstrated, practical; its further development will most likely be accomplished by the competent photo-engraver, who, with his years of practical experience at plate-making, will quickly get the best possible results out of the process, to which it is capable of being perfected.



Upper Picture—Thoroughly cleaning the cylinder with potash and sulphuric acid, the former to remove all grease, the latter, the stain.

Lower Picture—Transferring a section of the printed carbon tissue to the prepared cylinder.

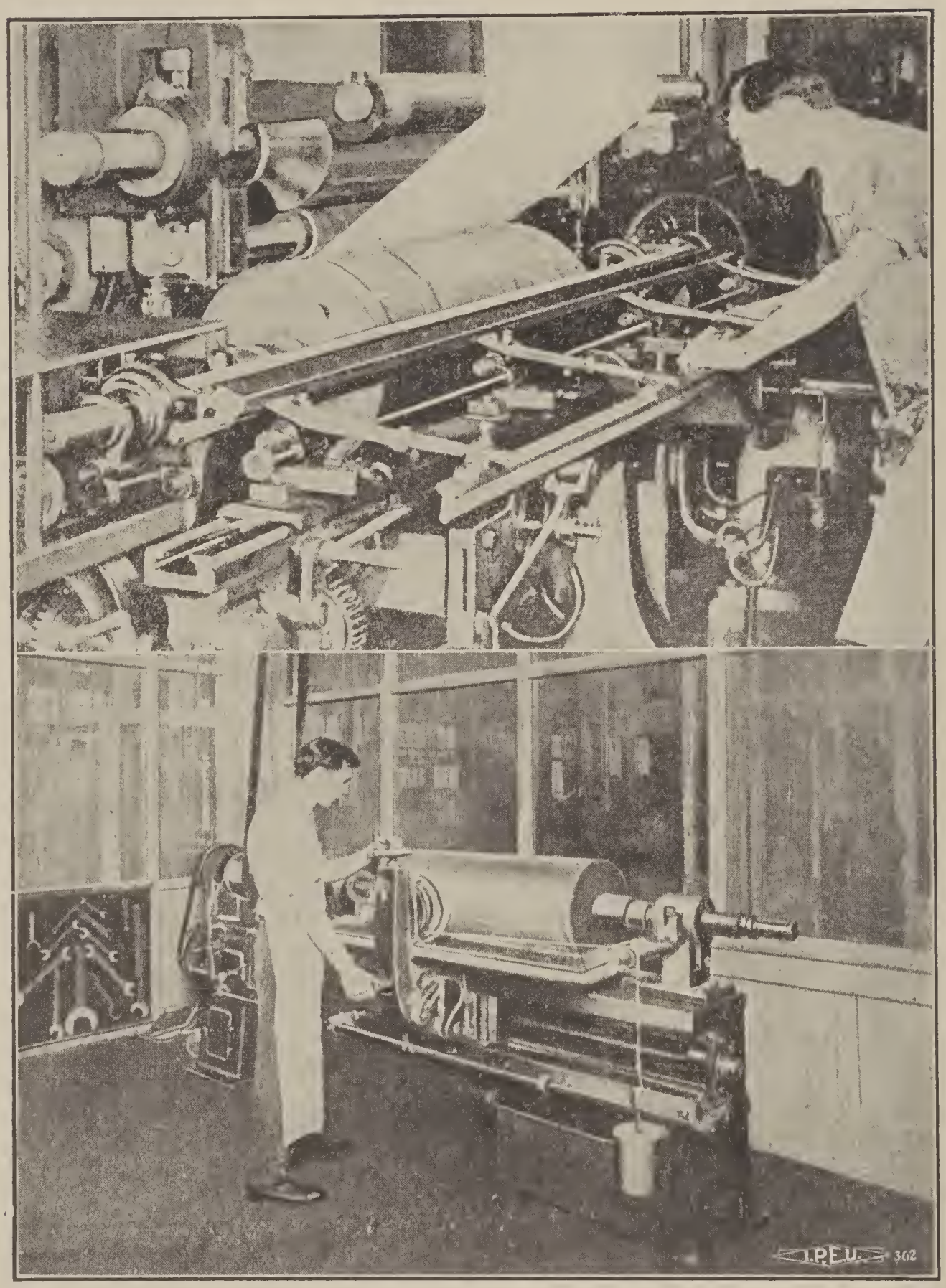
Illustrations from N. C. R. Weekly.



Upper Picture—Squeegeeing carbon tissue in firm contact with cylinder to remove all air bubbles.

Lower Picture—Etching cylinder, the gelatine film acts as a resist to the etching solution.

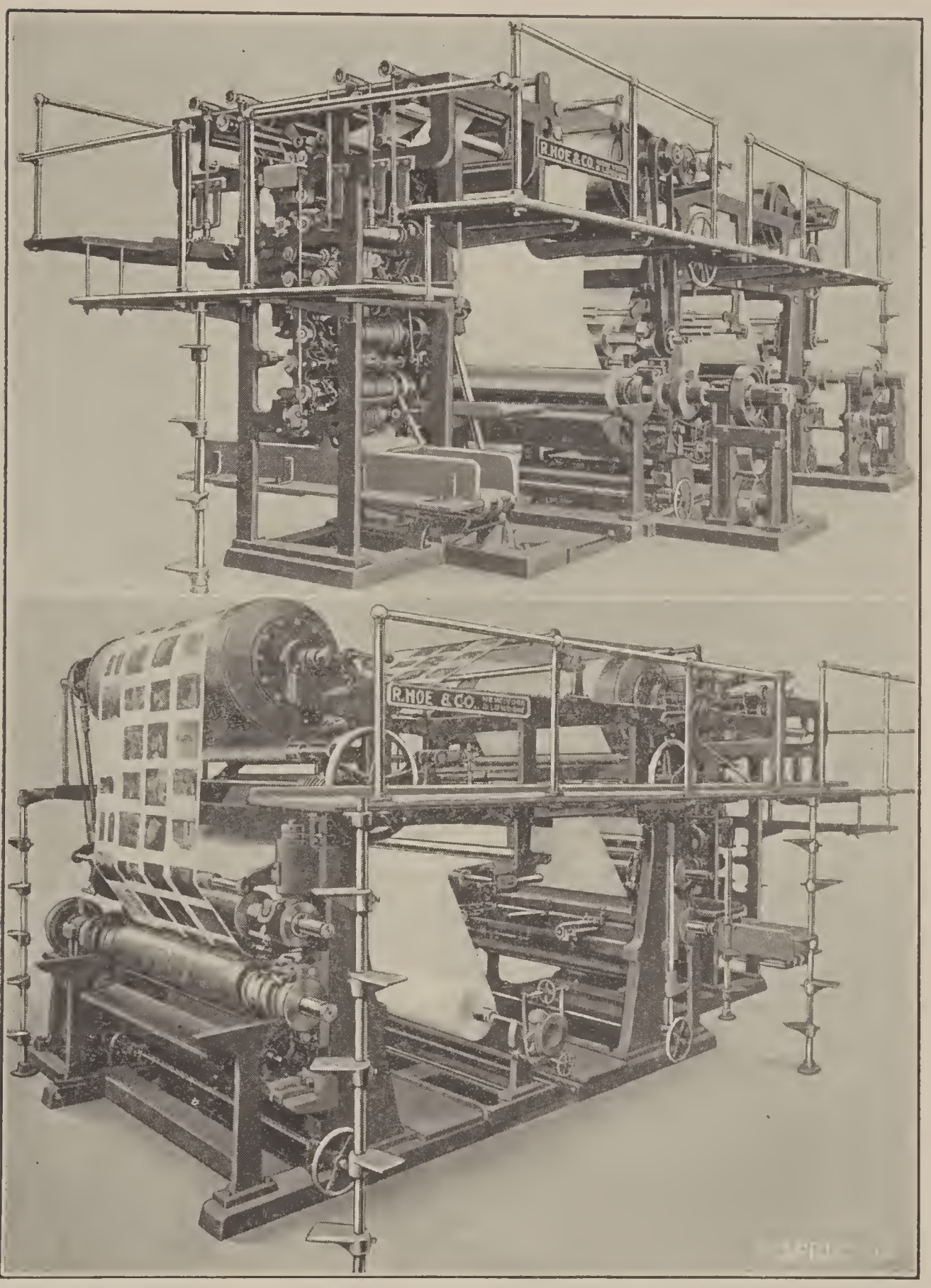
Illustrations from N. C. R. Weekly.



Upper Picture—Sectional view of Merten's press, showing etched cylinder and "doctor" in position; the latter scrapes perfectly clean all surface ink on the former.

Lower Picture—Removing etching from copper cylinder for future use, by means of a revolving stone.

Illustrations from N. C. R. Weekly.



Upper Picture—Showing cutter and folder attached to gravure press.

Lower Picture—Showing to advantage, etched cylinder, rubber and impression cylinder and on top large drying drum.

Photos by courtesy R. Hoe & Co.

NOTES, FORMULAE AND USEFUL TABLES FOR PHOTOGRAVURE AND ROTOGRAVURE

Negatives should possess a good scale of gradation and be fairly strong, though not hard, with plenty of detail. Shadows should not be clear glass. Dry plates or wet plates may be used.

Transparencies may be made by any process, they should be as thin as possible consistently with preservation of the scale of gradation. Provided detail is present in high lights, any increase in density in the transparency is not only unnecessary but undesirable.

DRY PLATE DEVELOPERS

HYDROQUINONE

No. 1		No. 2	
Hydroquinone	150 grs.	Sulphite Soda	2 oz.
Metabisulphite of Potash	10 grs.	Caustic Soda	100 grs.
Bromide of Potassium	50 grs.	Water (distilled)	20 oz.
Water (distilled)	20 oz.	Use equal parts No. 1 and No. 2.	

PYRO AND METOL

No. 1		No. 2	
Water	16 oz.	Water	64 oz.
Oxalic Acid	¼ oz.	Sulphite Soda	8 oz.
Pyrogallic Acid	1 oz.	Carbonate Soda	4 oz.
Metol	¼ oz.	Use 1 oz. No. 1 to 5 oz. 2.	
Bromide Potassium	16 grs.	Water 2 to 4 oz.	

PYRO

No. 1		No. 2	
Oxalic Acid	2 drs.	Water	60 oz.
Pyrogallic Acid	1 oz.	Sulphite Soda	10 oz.
Water	15 oz.	Carbonate Soda	5 oz.
Winter—1 oz. No. 1 to 2 oz. No. 2. Water, 8 oz.		**Summer**—½ oz. No. 1 to 1 oz. No. 2. Water, 9 oz.	

HYDROQUINONE SINGLE DEVELOPER

Hydroquinone	100 grs.
Sulphite Sodium	1½ oz.
Carbonate Sodium	3 oz.
Water	20 oz.

EIKONOGEN DEVELOPER

No. 1		No. 2	
Sodium Sulphite	2 oz.	Carbonate Potassium	1½ oz.
Eikonogen	½ oz.	Water	20 oz.
Water	20 oz.	Mix equal parts No. 1 and No. 2.	

EIKONOGEN SINGLE DEVELOPER

Sulphite Sodium	2 oz.
Carbonate Sodium	1 oz.
Water	20 oz.
Eikonogen	½ oz.

POSITIVE HYDROQUINONE-EIKONOGEN DEVELOPER

No. 1		No. 2	
Hydroquinone	40 grs.	Bromide Potassium	5 grs.
Eikonogen	120 grs.	Carbonate Sodium	60 grs.
Sulphite Sodium	480 grs.	Caustic Potash	30 grs.
Citric Acid	20 grs.	Water	20 oz.
Water	20 oz.		

Equal parts No. 1 and No. 2.

FIXING BATH

Hypo ..... 5 oz.
Water ..... 20 oz.
Metabisulphite of Potash .... ½ oz.

Always use fresh clear fixing bath to avoid trouble

REDUCERS FOR DRY PLATES

Permanganate of Potassium .. 1 dr.
Sulphuric Acid ..... 5 dr.
Water ..... 10 oz.

This reduces lights and shadows even on negative when plate is wet.

To reduce the high lights without material difference to shadows, have your negative dry before applying reducer.

A		B	
Ferricyanide of Potassium	1 oz.	Hyposulphite of Soda	1 oz.
Water	20 oz.	Water	5 oz.

For use, 1 dram A to 2 oz. B.

A strong reducing solution increases contrast, a weak one gives more uniform action.

INTENSIFIERS FOR DRY PLATES

A		B	
Bichloride of Mercury	1 oz.	Iodide of Potash	3 oz.
Water	30 oz.	Water	10 oz.

C

Acetate of Soda ..... 2½ oz.
Hyposulphate of Soda ..... 1½ oz.

Dissolve A B C separately, and add B to A until the red precipitate which is first formed is just dissolved. **Do not add** more of B solution than is necessary to accomplish this reaction, then add solution C.

This makes a very strong intensifier, which should be diluted to half strength for use; the stock solution must be kept in the dark or it will lose its strength very rapidly.

WET PLATE FORMULAES

BROMIDE COLLODIONS

Ether	10 oz.	Ether	10 oz.
Alcohol	10 oz.	Alcohol	10 oz.
Cotton	120 grs.	Iodide Cadmium	50 grs.
Iodide Ammonium	40 grs.	Iodide Ammonium	30 grs.
Iodide Cadmium	40 grs.	Bromide Cadmium	20 grs.
Bromide Cadmium	25 grs.	Cotton	100 grs.

		IODIZERS	
		Iodide Cadmium	600 grs.
Ether	12 oz.	Iodide Ammonium	210 grs
Alcohol	8 oz.	Iodide Sodium	210 grs.
Cellodion	190 grs.	Bromide Cadmium	210 grs.
		Alcohol	20 oz.

Use 1 part Iodizer to 15 parts Collodion.
This collodion should ripen for 4 or 5 days.

POSITIVE COLLODION

Ether ..... 10 oz.
Alcohol ..... 5 oz.
Cotton .....100 grs.
Iodide Cadmium ..... 50 grs.
Bromide Cadmium ..... 25 grs.
Alcohol ..... 5 oz.

SPOTTING MEDIUM FOR NEGATIVES

India ink and Payne's grey mixed.

RETOUCHING MEDIUM

Water ..... 20 oz.
Pale Gum Resin .....200 grs.
Gum Dammar ..... 90 grs.
Gum Mastic ..... 20 grs.
Oil of Juniper ..... 1 gr.
Oil of Turpentine .....2 to 4 oz.

GROUND GLASS SUBSTITUTES

(For retouching negatives)

Sulphuric Ether ..... 4 oz.
Benzole ..... 2 oz.
Alcohol .....½ oz.
Gum Sandarac .....100 to 150 grs.
Gum Mastic .....20 grs.
Gum Sandarac .....90 grs.
Ether ..... 2 oz.
Dissolve in ether and add ¼ to 1½ oz. benzole.

AUTOTYPE PHOTOGRAVURE CARBON TISSUES

No. 1. Red Chalk (is the duller red).
No. 2. Special Brown.
No. 3. Burnt Sienna (is the brighter red).
G. 3. For flat bed printing.

AUTOTYPE ROTARY GRAVURE CARBON TISSUES

G. 4. For Rotary Gravure printing.
G. 5. For Rotary Gravure printing.

CARBON TISSUE SENSITIZER

Bichromate Potassium ..... 1 oz.
Water .....20 to 30 oz.
Liquor Ammonia 880.....60 min.
Immerse in bath about 3 minutes.

If enclosed arc is used for printing and vigorous results are required, 60 to 120 grains bichromate instead of 1 ounce. The tissue should always be dried as rapidly as possible, squeezed on a chalked glass or Ferreo type sheet kept for the purpose in aired cupboard, temperature 65 degrees to 75 degrees Fahrenheit. The tissue should be used as quickly as possible after drying.

Cleaning the Copper Plate.—Rub with cotton wool charged with solution of American potash, strength unimportant. Rinse off the potash. Apply a fresh piece of cotton wool moistened with sulphuric acid (strength 1 to 20 of water). The potash is to remove the grease, the acid to remove the tarnish. Rinse, and with another pad of cotton wool rub with a paste of washed whiting moistened with three per cent. solution of ammonia. This should be continued until, on rinsing the plate, water will run off evenly, and not stand in drops or streaks on the surface. Rinse plate with hot water and dry with a clean linen cloth kept for the purpose.

Laying the Ground for Photogravure Plate.—Use a dusting box charged with finely powdered asphaltum. Stir up the dust with fan

and wait till heavier particles settle down. The longer the wait before putting plate in, the finer will be the ground. For a course grain wait 20 seconds. After putting plate in let it remain one and one-half to five minutes, according to grain required. It may be necessary to withdraw plate and shake up again two or three times to get a very fine ground. Many of the best workers use finely powdered resin for the ground, but it needs more skill and practice.

Fixing the Ground for Photogravure Plate.—Grip the plate in a hand vice, protecting it from the jaws with a slip of cardboard bent round the edge. Hold over a gas stove until color approaches a steel blue appearance.

Mounting and Developing the Resist for Photogravure.—Place grained copper plate in a dish of clean filtered water at a temperature of about 70 degrees Fahrenheit. Immerse tissue in the water face up. Remove air bells from face, with clean camel's hair brush, then turn over the tissue and remove air bells from the back. As soon as tissue is limp, raise the plate and let tissue come into contact with it, lifting both out together. Lay on a flat surface and apply squeegee. Remove superfluous moisture with blotting-paper and set aside in horizontal position for ten minutes. Develop with water at 100 degrees Fahrenheit. If over-exposed, raise to 120 degrees Fahrenheit. After developing is complete, rinse in cold water and set aside to dry. If required for etching at once, flow with equal parts methylated spirit and water. Drying can be assisted with whirler.

Varnishing Back and Margins of Photogravure Plate.—Apply varnish made of one part bitumen in five parts benzole, or use photo varnish with "thinner" if necessary. First draw a line around the picture with a ruling pen charged with thin varnish, and paint up to this line with the varnish.

ETCHING SOLUTIONS FOR PHOTOGRAVURE AND ROTOGRAVURE

14 lbs. Iron perchloride.
1 lb. Ferric hydrate.

(Ferric hydrate is the precipitate made by pouring ammonia into perchloride solution.) Just cover with water and stir well. Hot water is preferable. Test with Beaume hydrometer to 45 degrees. Dilute separate portions to 43 degrees, 40 degrees, 38 degrees, 36 degrees, 33 degrees. The weaker solutions penetrate gelatine more easily, and therefore should not be used until sufficient depth is obtained in the dark and middle tones with the stronger solutions.

After etching is completed, rinse quickly, and immerse the plate in a 10 per cent. solution caustic potash, rub the plate with a tuft of cotton wool to remove resist, rinse again and dry, then remove bitumen grain with benzole, then clean the plate with nitric acid, 1 per cent. solution, finally finishing with washed whiting and ammonia.

GLOSSARY

Alcohol—Rectified spirits of wine, a class of compounds.

Ammonia—Transparent pungent gas.

Asphaltum—A bitumen, or mineral pitch.

Benzole—A volatile liquid obtained by the distillation of coal tar.

Bichromate—A salt having two parts chromic acid to one part of the base.

Bromide—A compound of bromine.

Bromine—A non-metallic element related to chlorine and iodine.

Cadmium—A bluish-white ductile metal.

Carbonate—A compound of carbonic acid with a base.

Carbonic Acid—A gaseous, colorless compound of carbon and oxygen.

Chlorine—A greenish yellow gas, possessing great bleaching qualities.

Eikonogen—The sodium salt of amido, napthol, sulphorine acid.

Ether—A lighter than air fluid, produced by the distillation of alcohol with sulphuric acid.

Gum Mastic—A resin from the mastic tree.

Gum Sandarac—A resin.

Hydroquinone—Prepared commercially by oxidizing analine sulphate with bichromate of potash.

Metol—The sulphate of methyl, para, amidometa, cresol.

Negative Cotton—Composed of sulphuric acid, nitric acid, and cotton.

Nitric Acid—Composed of nitrogen and oxygen, obtained by action of sulphuric acid upon nitrate of potash.

Perchloride—A compound of an excess of chlorine with a base.

Potassium—A monad element, the metallic base of potash, an alkali obtained from ashes of certain plants.

Pyro—An abbreviated term for "Pyrogallol," a trihydroxybenzene derived from gallic acid by destructive distillation.

Soda—An oxide of sodium, a metallic element.

Sulphite—A salt of sulphuric acid.

Sulphuric Acid—A heavy corrosive liquid, composed of sulphur, oxygen, and water.

Turpentine—Juice of pine and fur trees.

Xylol or Xylene—A colorless oily liquid found in coal and wood tar.